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BUREAU OF PLANT INDUSTRY—Circular No. 129.

WILLIAM A. TAYLOR, Chief of Bureau.

MISCELLANEOUS PAPERS.

The Present Status of Date Culture in the Southwestern States . WALTER T. SWINGLE

The Present Status of the White-Pine Blister Rust . . . . PERLEY SPAULDING

The Work of the Umatilla Experiment Farm in 1912 . . . . R. W. ALLEN

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[Cir. 129—A]

THE PRESENT STATUS OF DATE CULTURE IN THE SOUTHWESTERN STATES.[1]

By Walter T. Swingle, *Physiologist in Charge of Crop Physiology and Breeding Investigations.*

It has been demonstrated by the work of the Department of Agriculture and the numerous date growers cooperating with it that the growing of standard varieties of dates, such as the Deglet Noor, by resident farmers in hot, dry, irrigated valleys is a very promising new line of fruit culture.

The satisfactory outcome of the experiments of the Bureau of Plant Industry in establishing the commercial culture of the date palm in the Coachella and Imperial Valleys has aroused much interest in date growing on a commercial scale. While the new industry has a very promising future if kept on a reasonable basis, unwarranted claims, such as are now being made by parties in some speculative enterprises, are bound to lead to great disappointment on the part of uninformed purchasers and are likely to jeopardize the future of the date industry and to hinder seriously the proper development of those regions best adapted to date culture.

It should be clearly borne in mind that date culture is a new industry, requiring experience and unusual skill on the part of the grower, and that it must be carried out in regions having an extremely hot summer climate—two causes which greatly increase the expense and risk of date culture to nonresident owners and corporations. The profits of date culture are almost impossible to estimate in advance, and the claims made on this point in many instances have been unintentionally exaggerated, especially since date culture as it now exists is supplemental to other types of farming. Further development and better organization of the date industry, both in regard to growing and to marketing, are needed before dates can safely be grown as the only crop. Any calculation as to the probable profits of date culture is of very little value, since this industry is new, little understood, and demands unusual knowledge and skill on the part of the grower.

It often happens that one of two adjoining orange orchards yields a very handsome profit even on land having a very high valuation,

[1] Issued June 7, 1913.

while the other with identical soil and climatic conditions is run at a loss to the owner. How much more is this likely to be the case in growing the date palm, which, unlike the orange, is a new crop plant and only imperfectly understood.

In particular, many nonresident owners or stock companies are at present very poorly equipped to carry on this industry with any certainty of success, since there are only a few competent managers to be had who understand date culture and who are able to endure the trying summer climate of the date-growing regions. It must be remembered that the planting of untested varieties is a very risky matter. The date palm, unlike all other commonly grown fruit trees, can not be budded or grafted, and if by any chance the variety planted proves to be not adapted to the soil or climate there is no remedy but to dig up the trees and either sell them at a sacrifice or, more probably, destroy them outright.

When we remember that offshoots of good varieties cost from five to ten times as much as grafted plants of other fruit trees and that to establish them in the field amounts to the rooting of a cutting in open ground, which is a very costly operation requiring great skill and the most scrupulous attention, we realize that to bring date palms into bearing costs very much more per acre than to grow any other orchard crop.

It is then obvious that growers who have only a limited capital to invest can scarcely afford to experiment with untested varieties. It is not enough that the varieties should be valuable in their native country, and it is not even enough that they should fruit successfully in this country. It must be proved that their culture can be carried on commercially with a reasonable certainty of success. Many otherwise desirable date varieties do not cure well, and consequently are hard to market. Each date variety must be studied most carefully over a term of years before its culture on a commercial scale can be recommended.

At present less than a dozen varieties among the 200 or more on trial at the Government date gardens in the Southwest can be said to be well enough known to warrant planting on a commercial scale. The Deglet Noor and the Tazizaoot can be recommended for orchard planting in the Coachella and Imperial Valleys of California; the Halawi, the Khadrawi, the Maktum, and the Birket el Hadji are promising for cooler regions, such as the Salt River Valley of Arizona, and may be planted in the California date regions on a scale not too large for the early markets; the Rhars is excellent for home use as a fresh date, but is of little commercial value; the Thoory[1] is a dry

[1] There are at least two distinct dates known by this name in Algeria, and only one, apparently the more uncommon one, is promising.

date of great promise, but it is as yet doubtful whether dry dates can be marketed advantageously on a large scale without an expensive publicity campaign.

It must be clearly understood that to plant other varieties that are new or inadequately tested involves a considerable element of risk. The fact that they appear satisfactory in the Old World deserts is no guarantee that they will grow, bear, and ripen fruit properly in the Southwest or that their fruit will prove acceptable to American buyers. Any planting of a variety on a large scale before it has been thoroughly tested must be considered as a speculation, since the planter runs the risk of finding out that the variety is unsuited to his conditions. Those having the means and the interest to test out such little-known varieties under as many different soil and climatic conditions as possible will render a valuable service to their community.

It would be much safer for those who expect to grow dates on a commercial scale to limit themselves at first to those varieties that have been tested by the Department of Agriculture and to learn all phases of the culture, curing, packing, and marketing of the fruit of one or more of the standard varieties. This is the best possible preparation for the efficient culture of new sorts when they have been tested enough in the Government or other adequately supervised testing gardens to render it desirable to test them on a commercial scale in private culture.

Much misinformation has been spread in regard to seedling dates. For some years the Department of Agriculture has been furnishing gratis seeds of choice dates to bona fide date growers so that the latter could at slight expense familiarize themselves with the culture of date palms. Up to June, 1911, imported offshoots were offered as a bonus to those who set out seedling dates in prescribed form. In this way it was possible for a farmer to learn date culture and even to obtain offshoots of choice imported varieties at little or no cash outlay, since it was possible to set out a seedling date orchard by plowing up and planting to dates narrow strips in fields planted to alfalfa or other field crops.

The quality of the seed distributed by the Department of Agriculture has steadily improved as it became possible to use pedigreed male palms in pollination of the date palms that furnished the seed. It is hoped in the case of the Deglet Noor that the Department will be able in a few years to supply seed of the best attainable breeding quality—i. e., giving the highest attainable percentage of seedlings of the Deglet Noor type.

Every grower of seedling dates has a chance of originating new and superior varieties, though it must be said that only a very small percentage of the seedling dates are good enough to warrant propagating the variety. Already a number of valuable seedling dates have been

originated in the Salton Basin, and doubtless many more will come to light within the next few years when the tens of thousands of seedling dates now being grown come into full bearing. Another very important advantage of seedling dates is that if kept properly isolated from imported date palms they are absolutely free from the Parlatoria and Phoenicococcus scales that infest most, if not all, the imported palms.

Seedling dates, however, are very poorly adapted to familiarizing the grower with the best methods of curing, packing, and marketing. As every tree is different, the crop varies greatly in quality and time of ripening and it is practically impossible to put any standard brands on the market. The proper marketing of dates can be learned much more easily by the grower of standard varieties propagated from offshoots. Every seedling date grower should plant as soon as possible an orchard with offshoots of Deglet Noor or other standard variety adapted to his conditions, so he can familiarize himself with the vitally important processes of curing, packing, and marketing dates.

On the other hand, every grower of imported dates should plant a seedling date orchard in the hope of originating valuable new varieties, to secure a supply of male trees to supply pollen, and to have plants upon which to experiment in transplanting, cutting offshoots, etc. Any proposal to grow seedling dates alone on a commercial scale as a source of profit is, to say the least, prematuer.

It must be said that any form of date culture is at present a risky business to the man who is not himself thoroughly acquainted with the local conditions and experienced in date culture as well. Nonresident owners, even though they plant offshoots of the best tested varieties, are at the mercy of their managers, and, as stated before, there are at present very few experienced managers who understand date culture well enough to be able to manage a commercial date plantation successfully.

To summarize, date growing is a new and promising but unusually difficult branch of fruit culture. It is most promising to the small resident owner who, by experimenting with seedling dates and a small planting of offshoots, has acquired the necessary experience to enable him to care for young date palms efficiently. Commercial plantings should be made only of tested standard varieties, such as the Deglet Noor, Tazizaoot, Birket el Haggi, and possibly one or two other varieties. If a wrong variety is planted great loss is entailed, as the trees can not be budded or grafted over into better varieties, but must be dug up and destroyed.

Seedling dates are useful to the beginner in giving him experience in handling date palms, in furnishing male trees for pollinating the

bearing trees, and also in giving rise to a very small percentage of new valuable varieties. Seedling dates, if grown alone, are not adapted to commercial culture but should be grown along with orchard plantings of standard varieties, which alone can be cured, packed, and marketed efficiently.

Extensive plantings of seedling dates alone should be made only by those having capital enough to afford to carry the plantation for a long time without profit. Nonresident investors should beware of seedling date culture as a commercial proposition.

The necessity of calling attention to the danger of loss through planting inadequately tested date varieties or large-scale planting of seedling dates must not be allowed to obscure the fact that there is a prospect and a bright one for the establishment of a new and profitable orchard crop. Indeed, the present warning has been rendered necessary by the very fact that date growing offers very unusual advantages to farmers residing in certain valleys of the Southwest and making a living by the culture of other crops, which has led to hopes, for the most part unwarranted, on the part of nonresidents to secure large profits by engaging in this industry, about which they know little except through biased accounts issued by promoters. The attempt by nonresidents to reap anything like the same advantages from date culture is very likely to lead to disappointment and failure and so tend to discredit a promising new fruit industry.

[Cir. 129—B]

THE PRESENT STATUS OF THE WHITE-PINE BLISTER RUST.[1]

By Perley Spaulding, *Pathologist, Investigations in Forest Pathology.*

INTRODUCTION.

Since the publication in 1911 of Bulletin No. 206 of the Bureau of Plant Industry, entitled "The Blister Rust of White Pine," considerable new information has been obtained concerning the blister rust and the fungus that causes it. This is of such a nature that it is thought best to publish it at once, so that the various persons who have to deal with the disease may have the fullest information possible with which to carry on their work.

FIELD CHARACTERS OF THE DISEASE.

In previous publications upon this subject[2] the writer has described those symptoms of the disease that seem to be distinctive and that are evident without the use of a microscope, that is, the "field characters" by which inspectors must recognize it. Those symptoms which were first recognized follow: (1) The presence of the fruiting bodies of the fungus and the cavities in the bark where they have been recently borne, (2) the stunted growth and compact appearance of the tops of badly diseased trees 3 to 5 years old, (3) the roughened, scaly bark on stems which bore fruiting bodies in previous years (see fig. 1 for healthy stem), (4) the abnormal swelling of affected stems of trees usually less than 6 years old, and (5), rarely, the local dying of the bark more or less completely around the young stem of trees 3 or 4 years old. Later an additional and more uncommon symptom was described by the writer,[3] namely, a coarse yellow mottling of the leaves and bark on the affected portion of trees which have shown the disease the previous year and which are about to die. This symptom has been mentioned by Klebahn[4] as occurring upon the needles of trees artificially inoculated with teleutospores of the fungus;

[1] Issued June 7, 1913.

[2] Spaulding, Perley.

(*a*) European currant rust on the white pine in America. U. S. Department of Agriculture, Bureau of Plant Industry, Circular 38, 4 p., 1909.

(*b*) Peridermium Strobi Klebahn in America. Science, n. s., v. 30, no. 763, p. 200–201, 1909.

[3] Spaulding, Perley. Notes upon Cronartium ribicola. Science, n. s., v. 35, no. 891, p. 146–147, 1912.

[4] Klebahn, H. Kulturversuche mit Rostpilzen. XII. Bericht (1903 und 1904). Zeitschrift für Pflanzenkrankheiten, Bd. 15, Heft 2, p. 87, 1905.

also by Pechon [1] on leaves of diseased trees in the open forest. Recently another symptom which is rather common has been noted on trees 5 or more years old. This is the dying of one or more of the lowest lateral branches which are located within the affected area on the stem of the tree. The dead branches are usually abnormally swollen at the base.

The stunted, compact appearance of the top is by no means a constant symptom of the disease. In a diseased lot of 10,000 trees 8 years old the writer could detect no difference in growth between apparently healthy trees and those which bore fruiting bodies by the hundred but which apparently bore fruiting bodies in 1912 for the first time. The stunting usually shows mostly in stock that is 4 and 5 years of age.

FIG. 1.—Stem of young, healthy white-pine tree. Note the smooth bark.

It can not be expected that any one or all of these symptoms will be found in all the trees affected with this disease. The swelling of the bark is the most constant symptom, but it may be lacking, while some other symptom is evident enough to show the presence of the disease in a suspected lot of trees.

There is some danger of confusing the roughened bark caused by the attacks of colonies of the insect *Chermes pinicorticis* Fitch with the roughening caused by the blister rust. There is a decided difference between the two forms of roughening. In the former the bark is very irregularly cracked and fissured and there is usually some evidence of the insects themselves (figs. 2 and 3). In the latter form (caused by *Cronartium ribicola*) the bark is usually fissured more deeply and many of the cracks extend horizontally (figs. 4 and 5). With the former the bark scales are rather thin, while with the latter they are apt to be decidedly thicker and heavier.

There can be no doubt that this fungus will establish itself here if allowed to do so. The writer has mentioned [2] the discovery of uredospores on Ribes leaves in one case where Ribes was near

[1] Pechon, L. Principales maladies des arbres et des peuplements forestiers. Bulletin, Société Centrale Forestière de Belgique. Ann. 14, libr. 6, p. 329–330, 1907.

[2] Spaulding, Perley. The blister rust of white pine. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 206, 88 pp., 5 figs., 2 pls., 1911.

diseased pine trees and where the fungus evidently transferred from the pines to the Ribes. In 1912 four cases of its occurrence upon Ribes were found in as many different States. Apparently the crisis with this disease is at hand and whatever measures are to be taken for its thorough eradication must be well started during 1913 or it will become permanently established here. It has been found that plants of Ribes are reestablishing themselves where they were removed in 1909.

FIG. 2.—A 4-year-old white-pine tree with chermes causing scaly bark. The chermes are still present, the white areas being their colonies.

The disease is reported as having been found for the first time in the State of Rhode Island upon white pines.

ORIGIN OF DISEASED STOCK.

In a previous publication [1] the writer stated that the white-pine blister rust has been reported as having been received in this country in white-pine stock sent by J. Heins' Sons, of Halstenbek, Germany; Levavasseur & Son, of Ussy, France; Barbier & Co., of Orleans, France; and E. T. Dickinson, of Chatenay, France.

In the spring of 1912 Dr. W. E. Britton, the State entomologist of Connecticut, informed us of the discovery of this disease in a shipment of 3-year-old white pines from the Union Nurseries, Schaum & Van Tol, of Oudenbosch, Holland.[2] This shipment, moreover, entered the country under the certificate of the Phytopathological Service of Holland. At about the same time Dr. H. T. Fernald, nursery inspector and State entomologist of Massachusetts, reported the discovery of the disease in stock received from Buch & Hermansen, of Halstenbek, Germany, and submitted specimens for verification of his identification of the fungus. Further, the

FIG. 3.—A 4-year-old white-pine tree with chermes causing scaly bark. The chermes have died out. At the left and below is the scar caused by some mechanical injury.

[1] Spaulding, Perley. The blister rust of white pine. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 206, 88 pp., 5 figs., 2 pls., 1911.

[2] Clinton, G. P. Plant diseases of Connecticut. Connecticut Agricultural Experiment Station, Report, 1912, p. 347–348.

writer in 1912 found the disease in a lot of white pines sent to this country by Buch & Hermansen in 1909, at which time the trees were apparently healthy.

INEFFICIENCY OF INSPECTION EVEN WHEN REPEATED.

In earlier publications [1] the writer has repeatedly called attention to the fact that a single inspection of a lot of white pines diseased with the blister rust will not result in the complete eradication of the infected trees. The inefficiency of inspection even when repeated, except as a temporary expedient, has become increasingly evident from the beginning in 1909, when the disease was first discovered here on pines. It has been found by personal investigations that the closest inspection possible will not remove all infected trees in a single large lot of trees.[2] That is, plainly diseased trees were found in 1910 and 1911 in a lot of 10,000 white pines which were in 1909 very closely inspected and from which all suspicious trees were then removed and destroyed. Moreover, after three personal inspections in previous years this lot of trees was found in 1912 to have quite a number which bore abundant fruiting bodies.

FIG. 4.—White-pine tree about 10 years old which has borne blister-rust fruiting bodies in previous years. Note the heavy scales of bark on a stem which at this age should be smooth.

Another parallel case is that of another lot of 10,000 white pines, imported when 3 years old. These were inspected in 1910 by a State official who knew the disease well. About 150 were removed and burned at that time, including every doubtful tree that was found. The Ribes plants in that locality were also pulled up and burned; there were but two, and these showed no signs of the disease. In 1912 reinspection showed that about 30 of the remaining trees bore very abundant fruiting bodies of the fungus. Many of the diseased

[1] Spaulding, Perley.

(*a*) The blister rust of white pine. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 206, 88 p., 5 fig., 2 pl., 1911.

(*b*) Notes upon Cronartium ribicola. Science, n. s., v. 35, no. 891, p. 146–147, 1912.

(*c*) ——— and Field, Ethel C. Two dangerous imported plant diseases. U. S. Department of Agriculture, Farmers' Bulletin 489, 29 p., 3 fig.

[2] Spaulding, Perley. Notes upon Cronartium ribicola. Science, n. s., v. 35, no. 891, p. 146–147, 1912.

trees had hundreds of distinct spore bodies. There was no evidence of these trees having been infected since reaching this country. The affected area was just below the lower branches, where it nearly always is found in newly imported trees bearing fruiting bodies of the fungus when received at the port of entry. These trees had not borne fruiting bodies in previous years, since the bark of the affected area was not scaly, as it is where fruiting bodies have previously been produced, and, furthermore, since all visibly diseased trees had been destroyed in previous years. So far as could be ascertained the disease had lain dormant for five years in these trees, only to break out with the most profuse production of fruiting bodies yet seen in this country.

FIG. 5.—A 5-year-old white-pine tree, showing scaly bark caused by the blister rust.

In 1909 [1] the writer concluded, from data afforded by numerous papers of European writers (which was the only available information), that inspection of diseased plantations for a few years might result in the final eradication of the disease, and this procedure was recommended rather than the more drastic one of total destruction of infected plantations. Since that time personal investigations, such as above described, have indicated that this procedure is not proving as effective as desired.

In the light of the above results it seems best to recommend the total removal and destruction of diseased plantations wherever possible. It is recognized that there are diseased plantations which it may be impossible to destroy, but these are few in number. Mere unwillingness or temporary inexpediency should not be substituted for impossibility in considering this matter. This does not necessarily mean that every plantation must be destroyed in a single year. The values involved and the number of trees are so large that it would be unwise for those States which have the largest numbers to undertake to replace all the diseased plantations in one year. It is believed that the removal of diseased plantations can be done gradually, those which are worst being taken first. It should especially be done where Ribes occurs in the vicinity of the diseased plantations. Much danger would thus be eliminated. In many cases the cost of

[1] Spaulding, Perley.

(*a*) European currant rust on the white pine in America. U. S. Department of Agriculture, Bureau of Plant Industry, Circular 38, 4 p., 1909.

(*b*) Peridermium Strobi Klebahn in America. Science, n. s., v. 30, no. 763, p. 200–201, 1909.

(*c*) Notes upon Cronartium ribicola. Science, n. s., v. 35, no. 891, p. 146–147, 1912.

continued inspection will more than replace the diseased plantations with healthy trees and this policy would be more economical to the State than to continue inspection. The national quarantine law prevents further importations of this disease, thus removing a great uncertainty regarding its status. At least three of the States—New Jersey,[1] New York,[2] and Connecticut[3]—have already destroyed entire shipments of white pines when the disease was found in them. The destruction of infected plantations is the logical continuation of this policy. It will rid the country of the disease and is apparently the only sure method of doing so.

VARIATIONS IN FRUITING.

This fungus apparently varies much in the abundance of fruiting bodies formed in different years.[4] There can be little doubt that weather conditions are largely responsible for this variation. In 1911 relatively few diseased trees were found bearing fruiting bodies of the fungus, but in 1912 a large number were found with them, even in plantations which had been carefully inspected before and from which all the diseased trees were removed and destroyed one or more years ago. Moreover, the trees which bore fruiting bodies in 1912 had them in great profusion, some trees being found which bore hundreds of peridia. This experience was quite general wherever careful inspection of diseased plantations was made.

A comparison of the monthly weather reports for the two years shows the following conditions for New York and New England: In March, 1911, the precipitation for some time had been so low that many city and town water supplies were very low, so much so as to cause serious apprehension. The precipitation for March, 1911, was slightly less than normal; for April it was very light and the weather was sunny; for May the precipitation was hardly half of the normal amount. These conditions the writer believes materially hindered the formation of fruiting bodies by the rust. In 1912 the conditions were quite different. The drought which prevailed in the spring of 1911 was broken, and water supplies began to assume their normal condition. In March, 1912, precipitation was very heavy, more than counterbalancing what the previous two months had lacked; April had excessive precipitation and cloudy weather, May had heavy precipitation, while June was somewhat deficient. Abundant precipitation just before the fruiting period, and even at that time,

[1] (Anonymous.) Forest Quarterly, v. 9, no. 2, p. 351–352, 1911.

[2] (Anonymous.) Op. cit., p. 359, 1911.

[3] Britton, W. E., and Walden, B. H. Inspection of imported nursery stock in Connecticut. Connecticut Agricultural Experiment Station, 12th Report, 1912, p. 222.

[4] Hawes, A. F. Suppression of white-pine blister rust disease. 4th Annual Report, State Forester, Vermont, p. 21–24. *In* Agriculture of Vermont, 1912.

seems to favor the fruiting of the fungus. Probably the suppression of fruiting bodies in 1911 had something to do with their abundance in 1912.

A number of European writers have definitely mentioned the time when this fungus fruits upon pines, their dates varying from March 19 to July 7. Very evidently the character of the location and season largely governs the date of fruiting. However, it has been found that this rust fruits earlier than most of the tree rusts. In this country *Cronartium ribicola* has been found in fruit upon pines from early April to early July, the time varying with the earliness of the spring, the warmth of the location, the altitude, and the elevation. Upon comparing this species with native species of Peridermium of the same district it is found that the white-pine blister rust fruits somewhat earlier than these species of Peridermium. That is, when the latter are in full fruit the white-pine blister rust is already past its maximum season, and if its fruits occur at all they are scattering, belated cases. So far as the writer's observations go, this is approximately true of all situations and localities. This may explain why this disease was not observed on pines until 1909, although it must have been in the country in small quantities before that year. One of the most prominent European mycologists[1] has plainly stated that this is decidedly earlier in Europe than other native species of Peridermium.

DISTANCE SPORES ARE DISTRIBUTED.

Some observations recently made by the writer[2] upon *Cronartium comptoniae* Arthur are interesting as indicating in a general way the distance that the two hosts of the white-pine blister rust must be separated in order to prevent the spread of the fungus from pines to Ribes. In localities where *Pinus rigida* Mill. and *Comptonia asplenifolia* Gaertner were growing in close proximity to each other it was found in June that the uredo stage of *Cronartium comptoniae*, which was then quite abundant, was present on the latter host within only a few yards (usually within 10 yards) of a diseased pine tree. That is, the æcidiospores on pines were apparently blown but short distances from their source. How far occasional spores may be blown is entirely problematical, as no good opportunity has yet been seen for getting evidence along this line. The æcidiospores of *Cronartium comptoniae* and of *C. ribicola* are so similar in size, shape, and general characters that it seems likely that what is true of the mechanical distribution of one will be essentially true

[1] Klebahn, H. Weitere Beobachtungen über die Blasenroste der Kiefern. Berichte, Deutsche Botanische Gesellschaft, Bd. 6, pp. XLV-LV, 1888.

[2] Spaulding, Perley. Notes on Cronartium comptoniae. Phytopathology, v. 3, no. 1, p. 62, 1913.

for the other. This might indicate that under ordinary conditions the white-pine blister rust will infect Ribes for a distance of about 10 yards from a diseased pine tree. But how far a really hard wind or a small whirlwind may carry these spores is entirely unknown.

It should be mentioned that in the vicinity of Geneva, N. Y., in 1912, the uredospores of *Cronartium ribicola* were apparently blown a distance of nearly half a mile, as some of the diseased Ribes were that distance from other known diseased Ribes.[1]

HOW THE FUNGUS IS CARRIED FROM ONE PLACE TO ANOTHER.

It has been generally supposed that the white-pine blister rust is carried from one locality to another only by means of infected white-pine trees. This is undoubtedly the way the disease reaches new localities in the majority of cases. European writers [2] have mentioned this as if it were the only means of transference of the disease and some even state that Ribes bushes, which were diseased one year did not show the disease the next year.[3] So far as we can find, few European writers have seriously considered that the fungus might be carried considerable distances except by means of diseased young pine trees, although some [4] have noted the absence of pines from the neighborhood of diseased Ribes bushes.

The experience in this country, however, seems to indicate that the fungus may be occasionally carried on dormant Ribes stock, and this possibility was suggested by Stewart in 1906 [5] and by the writer in 1911.[6] Occurrences of the disease upon Ribes where its origin could not be traced to diseased pines led to this assumption as a possible explanation of its otherwise inexplicable presence.

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[1] Stewart, F. C., and Rankin, W. H. Cronartium ribicola and the proscription of Ribes nigrum. (Abstract.) Phytopathology, v. 3, no. 1, p. 73, 1913.

[2] Tubeuf, Carl von.

(*a*) Vernichtung des Weymouthskiefernrostes. Praktische Blätter für Pflanzenschutz, Jahrg. 1, Heft 8, p. 63, 1898.

(*b*) Ueber die Verbreitung von Baumkrankheiten beim Pflanzenhandel. Mitteilungen, Deutsche Dendrologische Gesellschaft, p. 156–163, 6 fig., 1904.

Klebahn, Heinrich. Die Wirtwechselnden Rostpilze. Berlin, 1904, p. 382–387.

[3] Hennings, P. Ueber das epidemische Auftreten von Cronartium ribicola Dietr. im Dahlemer botan. Garten. Notizblatt, Königl. Botanischen Garten und Museum, Berlin, Bd. 3, no. 28, p. 172–175, 1902.

Fischer, Ed. Beiträge zur Kenntniss der schweizerischen Rostpilze. Bulletin de l' Herbier Boissier, t. 6, no. 1, p. 16–17, 1898.

Jaczewski, A. A. Ezhegodnik sviedieniĭ o boliezniakh i povrezhdeniiakh kul'turnykh i dikorastushchikh poleznykh rasteniĭ. God. 3, p. 142–143, 1908.

[4] Klebahn, Heinrich. Die Wirtwechselnden Rostpilze. Berlin, 1904, p. 382–387.

Bondartseva, A. S. Rastitel'nye parazity kul'turnykh i dikorastushchikh rasteniĭ sobrannye v Kurskoĭ gubernii lietom 1901, 1903–1905 godov. (Les parasites végétaux des plantes cultivées et sauvages, recueillis dans le gouvernement de Koursk en 1901, 1903–1905.) Acta Horti Petropolitani, t. 26, p. 19, 1906.

Iwanoff, K. S. Die im Sommer 1898 bei Petersburg (Russland) beobachteten Krankheiten. Zeitschrift für Pflanzenkrankheiten, Bd. 10, Heft 2, p. 99, 1900.

Hennings, P. Loc. cit.

[5] Stewart, F. C. An outbreak of the European currant rust (*Cronartium ribicola* Dietr.). New York State Agricultural Experiment Station, Technical Bulletin 2, p. 61–74, 3 pl., 1906.

[6] Spaulding, Perley. Notes upon Cronartium ribicola. Science, n. s., v. 35, no. 891, p. 146–147, 1912.

In 1911 the writer secured the only direct evidence that the fungus may be carried on dormant Ribes stock that has yet been published. This was the discovery of a single leaf upon an artificially inoculated Ribes bush which had the telial stage upon the petiole (fig. 6) and even on the slight stipules at its base. The statement[1] concerning it read:

> The finding of the teleuto stage of the fungus affecting the stipule and bracts of a Ribes leaf in the greenhouse is believed to practically prove that the fungus may sometimes attack the bud scales of dormant bushes and cuttings; this very probably explains the anomalous appearance of this fungus in this country upon Ribes at Geneva, N. Y., and possibly in Kansas.

It was intended to say: "The finding of the teleuto stage of the fungus affecting the petiole and stipules * * * ," but by some mistake it read as above quoted. While this is not complete proof that the fungus may occasionally attack the bud tissues by way of the petiole, such proof has been sought by the writer and is still being sought, not only in independent experiments but also in experiments in cooperation with the New York State Agricultural Experiment Station.

Fig. 6.—Ribes petiole showing telial stage of *Cronartium ribicola* progressing downward from the leaf blade. (Drawn in dry condition with a camera lucida.)

LEGISLATION.

The various States of this country have as varied laws against plant diseases as could well be devised. They range in efficiency from zero to nearly perfect. A number have laws authorizing the proper State official to declare and enforce quarantine against especially dangerous plant diseases. This power has been used in but few cases, however. In 1912 the nursery inspector of Massachusetts prohibited any further importation of any 5-leaved pine stock from Europe into that State because of the white-pine blister rust. This order took effect June 1, 1912.

Soon afterward the Sixty-second Congress, in its second session, passed the bill previously known as the Simmons bill for the regulation of the importation of nursery stock, etc. This was approved and became the official "Plant Quarantine Act, August 20, 1912," this being the short title for it. This is the only national legislation for this purpose which has ever been enacted. Because it applies to the white-pine blister rust and is so recent, a brief statement of its essential features will be useful.

Section 1 provides for the importation of nursery stock only under permit from the Secretary of Agriculture. A foreign certificate of

[1] Spaulding, Perley. Notes upon Cronartium ribicola. Science, n. s., v. 35, no. 891, p. 146-147, 1912.

inspection is also required. Such permit must be granted when the requirements are fulfilled. Nursery stock may be imported for experimental or scientific purposes by the Department of Agriculture. Where a foreign country has no inspection service nursery stock may be admitted under the regulations of the Secretary of Agriculture.

Section 2 requires the customhouse officials to notify the Secretary of Agriculture of the arrival of nursery stock at the port of entry; also a similar notification by the person receiving the stock at port of entry before removing it or shipping it to any other point, which notification shall also be sent to the proper official of the State to which such stock is destined. This notification must give the name and address of the consignee, the nature and quantity of stock to be shipped, and the country and locality where the stock was grown, unless such stock has been inspected by the proper State official.

Section 3 provides for the plain and correct labeling of the stock offered for entry, so that the nature and quantity of stock, the country and locality where grown, and the name and address of the shipper and consignee may be determined.

Section 4 provides for similar labeling of interstate shipments, unless they have already been inspected by the proper State official.

Section 5 gives the Secretary of Agriculture power to quarantine particular plants or plant products not included under "nursery stock" when necessary in order to exclude diseases or insects dangerous and new to this country. A public hearing shall be given before such orders shall take effect.

Section 6 defines nursery stock.

Section 7 provides for quarantine of plants or plant products from foreign countries or localities, regardless of the use to which they are to be applied. A public hearing shall be given before an order takes effect. The provisions of this section apply to the white-pine blister rust, potato wart, and Mediterranean fruit fly from the passage of this act.

Section 8 provides for quarantine of any State or locality in this country to prevent the spreading of dangerous diseases or insects which are new or not previously widely prevalent in this country. A public hearing shall be given before an order under this section takes effect.

Section 9 provides for suitable rules for carrying out the purposes of this act.

Section 10 provides penalties for violations of the provisions of this act. A common carrier proving that it did not knowingly violate this act shall not be deemed guilty.

Section 11 defines "person" as used in this act; also makes corporations and firms responsible for their employees' acts.

Section 12 provides for a Federal Horticultural Board consisting of five members, not more than two of whom shall be appointed from each of the Bureaus of Plant Industry, Entomology, and Forest Service.

Section 13 appropriates $25,000 for carrying out the provisions of the act.

Section 14 makes the act effective on and after October 1, 1912.

The permit system simply furnishes the Secretary of Agriculture certain definite information about each shipment, which it is necessary to have in order to have the proper inspection made. The foreign certificate of inspection is required, not because it is of value now, but because this requirement will lead to closer attention by foreign inspectors to the health of plants certified by them and thus lead to a better class of stock being offered for entry. The actual inspection of imported stock is left entirely to the proper State officials, who are furnished full information concerning shipments of nursery stock coming to their States.

The most important feature of the bill is the quarantine power given against dangerous new diseases and insects, which may be enforced against any foreign country or locality or any State or locality within this country.

The Federal Horticultural Board, which administers the provisions of the act, has issued the following notice regarding white-pine blister rust:

NOTICE OF QUARANTINE NO. 1.

(Issued pursuant to sec. 7 of the Plant Quarantine Act.)

WHITE-PINE BLISTER RUST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., September 16, 1912.

The fact has been determined by the Acting Secretary of Agriculture that a tree disease known as White-Pine Blister Rust (*Peridermium strobi* Kleb.), new to and not heretofore widely prevalent or distributed within and throughout the United States, exists in the following countries, viz, Great Britain, France, Belgium, Holland, Denmark, Norway, Sweden, Russia, Germany, Austria, Switzerland, and Italy.

Now, therefore, I, Willet M. Hays, Acting Secretary of Agriculture, under authority conferred by section 7 of the act approved August 20, 1912, known as "the Plant Quarantine Act," do hereby declare that it is necessary, in order to prevent the introduction into the United States of the White-Pine Blister Rust, to forbid the importation into the United States from the hereinbefore-named countries of the following species and their horticultural varieties, viz, white pine (*Pinus strobus* L.), western white pine (*Pinus monticola* Dougl.), sugar pine (*Pinus lambertiana* Dougl.), and stone or cembrian pine (*Pinus cembra* L.).

[Cir. 129]

Hereafter and until further notice, by virtue of said section 7 of the act of Congress approved August 20, 1912, the importation for all purposes of the species and their horticultural varieties from the countries named is prohibited.

Done at Washington this 16th day of September, 1912.

Witness my hand and the seal of the United States Department of Agriculture.

[SEAL.] WILLET M. HAYS,
Acting Secretary of Agriculture.

Circular No. 41 of the Office of the Secretary of the United States Department of Agriculture, entitled "Rules and Regulations for Carrying Out the Plant Quarantine Act," gives the rules and regulations adopted for carrying out the provisions of the act.

It is known that since the passage of the Plant Quarantine Act shipments of some of these quarantined species of pine have been received in this country under false names. It should be remembered that the penalty for violating the act is a maximum fine of $500 or imprisonment not exceeding one year.

[Cir. 129—C]

THE WORK OF THE UMATILLA EXPERIMENT FARM IN 1912.[1]

By R. W. Allen, *Collaborator, Office of Western Irrigation Agriculture.*

INTRODUCTION.

The average annual rainfall on the Umatilla Project is only about 9 inches. The altitude averages 470 feet, and the growing season is relatively long. Much of the soil on the project is sandy and practically all of it is deficient in vegetable matter, so that it is easily moved by wind, and its water-holding capacity is not high. The size of the farm unit is limited to 40 acres. In 1912 the average irrigable area of the 295 farm units on the project was about 30 acres, and an average of only 16 acres per farm unit was actually irrigated.

Fig. 1.—View showing the buildings on the Umatilla Experiment Farm.

On account of the small size of these farms it is necessary that systems of intensive agriculture be established. The low altitude and long growing season are well suited to the production of certain truck crops and fruits and to dairy farming. One of the first requirements in successfully establishing crop production on the project is to supply the soil with organic matter, so as to reduce the damage by soil blowing and to increase the water-holding capacity. It is neces-

[1] Issued June 7, 1913.

The Umatilla Experiment Farm is located on the Umatilla Reclamation Project, about 2 miles north of Hermiston, Oreg. The farm contains 40 acres of land withdrawn from entry in 1908 by the Department of the Interior for use as an experiment farm. It is maintained by the Oregon Agricultural Experiment Station and is operated in cooperation with the Bureau of Plant Industry, United States Department of Agriculture, under a cooperative agreement. Operations were begun in 1909. The buildings (see fig. 1) used were constructed by the United States Reclamation Service and by the Oregon Agricultural Experiment Station. The expenses of the farm are shared equally by the Oregon station and the Office of Western Irrigation Agriculture. The investigational work is under the immediate supervision of a farm superintendent, who is also a collaborator of the Bureau of Plant Industry.

sary also that crop varieties suited to the conditions on the project be found and that cultural methods suited to local conditions be determined.

Since its establishment in 1909 the Umatilla Experiment Farm (fig. 1) has been devoted to the investigation of these problems. The work of the farm is mainly horticultural and is at present confined chiefly to testing varieties of orchard fruits, small fruits, and truck crops and to investigating methods of producing these crops. All the experiments are under irrigation.

CONDITIONS ON THE PROJECT.

CLIMATIC CONDITIONS.

Measurements of precipitation, evaporation, wind velocity, and temperature are made in cooperation with the Biophysical Laboratory of the Bureau of Plant Industry. A summary of these climatological observations in 1912 is given in Table I.

TABLE I.—*Summary of climatological observations at the Umatilla Experiment Farm in 1912.*

Character of data.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Precipitation.....inches..	2.22	0.67	0.49	0.61	1.25	0.97	0.05	1.18	0.10	0.29	0.54	0.13	8.50
Evaporation.....do....	.....	.....	.....	3.98	5.21	7.51	8.23	5.68	3.87	2.98	.78	.25	[1]38.49
Wind velocity per hour, miles.....	2.5	4.0	3.3	2.5	3.1	5.3	4.4	3.8	2.5	3.5	1.7	4.3	3.4
Temperature:													
Maximum.....° F..	52	58	71	78	91	104	102	102	87	78	62	63	104
Minimum.....do....	−18	16	15	26	35	43	48	41	32	23	20	12	−18
Mean.....do....	29	40	41	52	61	69	72	69	59	48	42	35	51

[1] Evaporation for 9 months, April to December, inclusive.

The dates of the last spring frosts and first autumn frosts from 1909 to 1911, inclusive, were obtained from the local office of the Reclamation Service at Hermiston, about 2 miles from the experiment farm. In 1912 the observations were made at the farm. These data for the four years 1909 to 1912, inclusive, are given in Table II.

TABLE II.—*Killing frosts at or near Hermiston, Oreg., 1909 to 1912, inclusive.*

Years.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		°F.		°F.	*Days.*
1909	Apr. 21	27	Oct. 16	30	178
1910	Apr. 30	27	Oct. 15	31	168
1911	Apr. 20	31	Sept. 23	26	156
1912	Apr. 16	31	Oct. 6	31	173

CROP CONDITIONS.

The crop conditions on the Umatilla Project were only fairly satisfactory in 1912. Late spring frosts did some damage to the tender small fruits, particularly strawberries. A destructive windstorm on June 20 damaged all crops to some extent and seriously injured some of the truck crops.

In 1912 the total irrigable area of the farms on the project was 9,091 acres, included in 295 farm units. Of this an area of 4,600 acres was actually irrigated. Young orchards not yet in bearing occupied 1,175 acres, and green-manure crops and other miscellaneous crops which were not harvested occupied 207 acres, so that the total area of crops harvested was 3,218 acres. The acreage, yields, and farm values of the crops grown on the project in 1912 are stated in Table III. The figures were obtained from the United States Reclamation Service.

TABLE III.—*Acreage, yields, and farm values of crops grown on the Umatilla Project in 1912.*

Crop.	Area (acres).	Yield.				Per unit of yield.	Farm values.		
		Unit.	Total.	Per acre.			Total.	Per acre.	
				Average.	Maximum.			Average.	Maximum.
Alfalfa	2,442	Ton...	8,388	3.43	8	$7.00	$58,716	$24.00	$56.00
Clover	34	...do...	36	1.06	6	7.00	252	7.42	42.00
Rye hay	626	...do...	335	.54	2½	5.00	1,675	2.68	12.50
Corn fodder	38	...do...	57	1.50	12	6.00	342	9.00	72.00
Berries	26	Pound	22,600	869	6,400	.11½	2,599	100.00	736.00
Grapes	52	...do...	26,000	500	3,200	.04	1,040	20.00	128.00
Melons	18	...do...	35,200	1,956	4,000	.05	1,760	97.80	200.00
Onions	4	Ton...	54	13.50	16	20.00	1,080	270.00	320.00
Potatoes	94	...do...	553	5.90	10	15.00	8,295	88.40	150.00
Artichokes	6	...do...	25	4.17	10	20.00	500	8.34	200.00
Garden	328	...do...	48	.15	4	20.00	960	2.92	80.00
Less duplications	450								
Total or average	3,218						77,219	24.00	

FIELD EXPERIMENTS.

The field experiments in progress at the experiment farm in 1912 had to do chiefly with the following: (1) The testing of fruit varieties and methods of their production; (2) the indentification and testing of varieties of garden and truck crops; (3) experiments with methods of increasing the supply of organic matter in the soil, including tests of several green-manure crops; (4) variety tests of numerous hardy shrubs and trees suitable for ornamental purposes and as windbreaks; and (5) tests of different irrigation methods. The arrangement of the fields and the location of the experiments in 1912 are shown in figure 2. A brief description of these experiments

follows, together with a discussion of some of the more important results.

FRUIT VARIETIES.

The fruit variety tests include 11 different kinds of fruit, of which 327 different varieties are being grown. The number of individuals being tested in each variety varies from 2 of quinces, nectarines, and

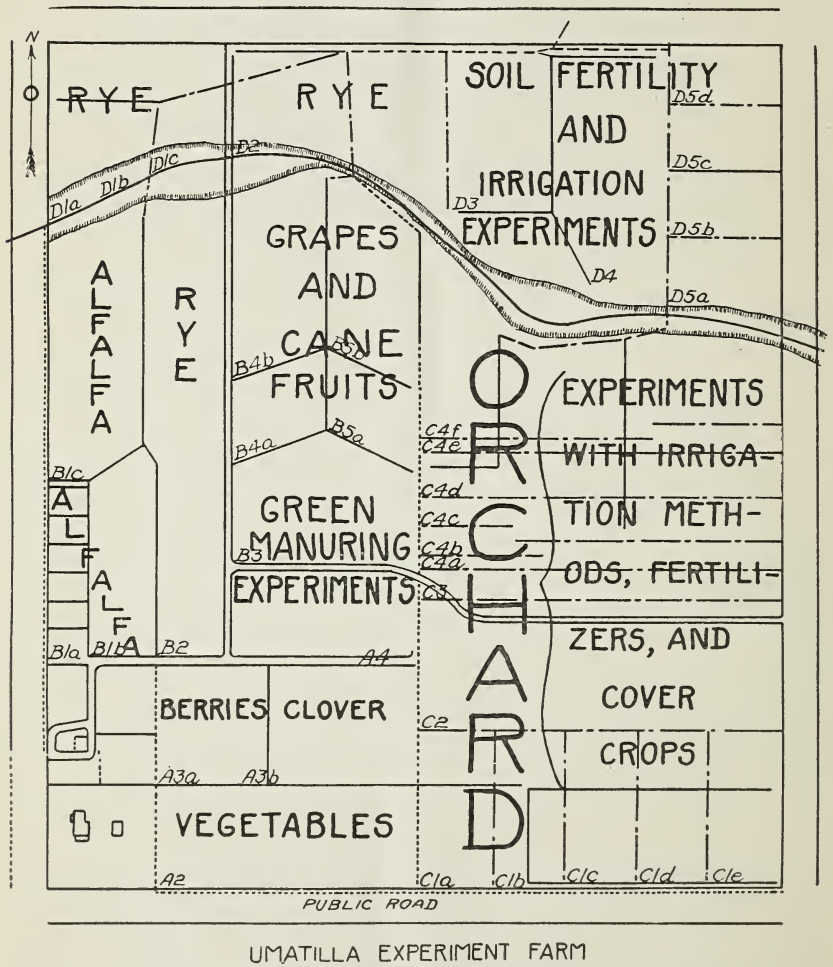

FIG. 2.—Diagram of the Umatilla Experiment Farm, showing the arrangement of the fields and the location of the experiments in 1912.

apricots to 25 of strawberries. The total number of individuals in the fruit variety tests is 3,544. The names of the fruits and the number of varieties and individuals of each are given in Table IV.

TABLE IV.—*List of fruits in the variety tests at the Umatilla Experiment Farm in 1912.*

Kind of fruit.	Number of varieties.	Number of individuals in each variety.	Kind of fruit.	Number of varieties.	Number of individuals in each variety.
Apples	47	3	Cane fruits	5	12
Pears	14	3	Do	37	24
Quinces	7	2	Strawberries	75	25
Prunes and plums	22	3	Grapes	28	8
Cherries	25	3			
Nectarines and apricots	17	2	Total	327	3,544
Peaches	50	3			

Following are the varietal names of the fruits listed in Table IV:

Apples.—Alexander, Red Astrachan, Oldenburg (*Duchess of Oldenburg, Duchess*), Goodwin, Gravenstein, Tompkins King (*Tompkins County King*), Maiden Blush, Fameuse (*Snow*), Yellow Transparent, Akin (*Aiken, Akin Red*), Arkansas Black, Babbitt, Baldwin, Yellow Bellflower, Ben Davis, Bennett, Delicious, Gano, Grimes (*Grimes' Golden*), Jonathan, Lady, Lawver (*Delaware Red Winter*), McIntosh, Arkansas (*Mammoth Black Twig*), Yellow Newtown, Northern Spy, Oregon Winter (*Oregon Red Winter*), Orenco, Ortley, Red Cheek, Rome Beauty, Esopus (*Spitzenberg*), Stayman Winesap, Wagener, Wealthy, White Pearmain (*White Winter Pearmain*), Willow (*Willow Twig*), Winesap, Banana (*Winter Banana*), Winterstein, York Imperial.

Crab apples.—Hyslop, Martha, Red (*Red Siberian*), Yellow Siberian, Transcendent, Whitney (*Whitney's No. 20*).

Pears.—Bartlett, Anjou, Bosc, Clairgeau, Clapp, Comice, Flemish (*Flemish Beauty*), Howell, Idaho, Madeleine, Rossney, Seckel, Winter Bartlett, Winter Nelis.

Quinces.—Angers, Apple, Bourgeat, Champion, Pineapple, Rea (*Rea's Mammoth*), Smyrna.

Prunes.—German, Hungarian, Italian, Agen (*Petite*), Pond, Sergeant (*Robe de Sergeant*), Sugar, Tragedy, Golden Drop (*Coe's Golden Drop, Silver*).

Plums.—Abundance, Bradshaw, Burbank, Lombard, Maynard, Peach, Satsuma, Sultan, Wildgoose, Yellow Egg, Wickson, Gold, Wyant, Surprise, Terry.

Cherries.—Bing, Centennial, Chapman, Deacon, Early Purple, Elton, Wood (*Governor Wood*), Lambert, Lewelling, Montmorency Ordinaire, Windsor, Napoleon (*Royal Ann*), Spanish (*Yellow Spanish*), Baldwin, Richmond (*Early Richmond*), English Morello (*Wragg*), Kentish, Late Duke, Lutovka, May Duke, Large Montmorency, Olivet, Ostheim, Vladimir.

Nectarines.—Boston, Humboldt, New White, Stanwick.

Apricots.—Alexander, Alabis, Black, Blenheim, Hemskirke, Budd (*J. L. Budd*), Moorpark, Newcastle (*Newcastle Early*), Peach, Royal, Routier (*Routier's Peach*), Smyrna, Tilton.

Peaches.—Dewey (*Admiral Dewey*), Alexander, Arp (*Arp Beauty*), Australian Saucer, Bilyeu, Briggs (*Briggs Red May*), Champion, Columbia, Early Crawford, Late Crawford, Crosby, Elberta, Fitzgerald, Foster, George Late (*George's Late Cling*), Globe, Greensboro, Hale Early, Heath (*Heath Cling*), Imperial Early, Sims Cling, Levy (*Levy's Late*), Lovell, McDevitt (*McDevitt's Cling*), McKevitt, Morris (*Morris White*), Mountain Rose, Muir, Opulent, Perfection, Persian Cling, Phillips (*Phillips's Cling*), Picquet (*Picquet's Late*), Runyon (*Runyon's Orange*), Salway, Sellers, Levis Cling, Sneed, Strawberry, Susquehanna, Triumph, Tuskena (*Tuscan. Tuscan Cling*), Van Buren (*Van Buren Dwarf*), Wheatland, Smock, Webers Prize, St. John (*Yellow St. John*), Belle (*Belle of Georgia*), Carman, Chinese Cling.

Grapes.—Black Hamburg, Black Prince, Flame Tokay, Mission, Muscatel, Rose of Peru, Agawam, Brighton, Catawba, Campbell, (*Campbell Early*), Delaware, Eaton, Early Ohio, Winchell (*Green Mountain*), Isabella, Lindley, McPike, Diamond (*Moore's Diamond*), Moyer, Niagara, Pocklington, Woodruff (*Woodruff's Red*), Wyoming. In commercial planting four additional varieties are under trial: Concord, Moore (*Moore's Early*), Salem, and Worden.

Currants.—Champion (*Black Champion*),[1] Naples (*Black Naples*),[1] Cherry, Fay (*Fay's Prolific*), Perfection, White Grape, Lee (*Lee's Prolific*).[1]

Gooseberries.—Downing, Industry, Josselyn, Oregon (*Oregon Champion*), Pearl, Smith (*Smith's Improved*), Victoria, Houghton.

[1] Black sort.

Raspberries.—Brandywine, Cardinal, Cumberland, Cuthbert, Loudon, Miller, Columbian, Gregg, Haymaker, Kansas, Munger, Shaffer (*Shaffer's Colossal*), Johnson (*Johnson's Sweet*), Atlas.

Dewberries and blackberries.—Mayes (*Lutin Improved*), Gardenia, Lucretia, Premo, Early Harvest, Eldorado, Erie, Kittatinny, Lawton, Mercereau, Rathbun, Snyder, Wilson (*Wilson's Early*), Ward.

Miscellaneous brambles.—Phenomenal, Loganberry, Himalaya, Mammoth, Evergreen, Japanese wineberry.

Strawberries.—Arizona (*Arizona Everbearing*), Beedler, Bismarck, Brandywine, Bubach, Cardinal, Clark (*Clark's Seedling*), Climax, Dornan, Glen Mary, Gold Dollar, Gandy, Hopkins (*Hopkins's Choice*), Hummer, Klondike, Thompson (*Lady Thompson*), Magoon, Mark Hanna, Michel (*Michel's Early*), Midnight, Miller, Nick Ohmer, New York, Oregon (*Oregon Ironclad*), Pride (*Pride of Michigan*), Sample, Dunlap (*Senator Dunlap*), 16 to 1, Splendid, Tennessee (*Tennessee Prolific*), Texas, Thompson No. 2, Woolverton, William Belt, Auto, Autumn (*Autumn Bell*), Bederwood, Corsican, Fendall, Goodluck, Kansas, Marshall, Oswego, Parker Earle, Paul Jones, Pocomoke, Sharpless, St. Lewis, August Luther, Chesapeake, Clyde, Ozark (*Early Ozark*), Excelsior, Gibson, Haverland, Washington (*Lady Washington*), Longfellow, Morse, New Oregon, Virginia, Warfield, Acme, Aroma, Buster, Crescent, Enormous, Heritage, Highland, Lovett, Parson (*Parson's Beauty*), Stevens (*Stevens's Late Champion*), Pride (*Downing's Pride*), South Dakota No. 1.

Separate areas of grapes and pears of sufficient size to give figures on yields per acre and similar data are being grown. Included in the experiments on methods of building up the soil are 4 acres of apples and $1\frac{3}{4}$ acres of peaches, which will be used to determine yields.

Apples have proved to be the most hardy tree fruit under trial, there having been less loss of trees and a better growth throughout. This is particularly true on the coarse sandy soils of the district. In locations where there is seepage or where silt-loam soils prevail peaches, pears, and cherries make a rapid and strong growth. Pear trees frequently act peculiarly the first year. Many of them remain green and appear fresh, but do not leaf out. Some of these start the second year and occasionally do better than those that started into growth the first season. The reason for this suspension of growth has not been determined. The Bartlett pear appears to be the hardiest variety in the experiment. Observations on the project indicate that pears are doing much better on the heavy soils than on the sandy ones.

Prunes and plums do not succeed as well as apples on the sandy soils. Such varieties as the Peach, Maynard, Sergeant, and Abundance make a rapid growth. Italian, Pond, and Golden Drop (*Silver*) prunes do fairly well when once established on light soils, but heavy losses are frequent.

Conditions on the project appear to be less favorable to the growth of cherries than to that of any other tree fruit tested. The sour cherries are much more hardy than the sweet varieties. This fruit will probably sustain some loss from frost on account of its comparatively early blossoming.

Peaches do well on silt soils and when once established make a strong growth on the sand. Observations throughout the district show that peach buds are more subject to winter freezing on the light than on the heavier soils, and the early blossoming of this fruit ren-

ders it liable to occasional loss from spring frost. Peaches are not as dependable a crop as apples and grapes, which blossom later in the season.

Desirability of small nursery stock.—Large or old trees in which there is an excessive quantity of wood frequently dry out, thus preventing proper growth and frequently causing heavy losses in newly planted orchards. As a check upon the observations made under field conditions a small experiment was carried out at the experiment farm in 1912 in which pear and cherry trees were used. These friuts have been the most difficult to get started. One-year-old trees, varying in size from the largest obtainable down to those less than 2 feet in height, were planted and cut off at varying distances from the ground. The experiment has shown conclusively that large trees are not desirable on account of the wood drying out, that small and medium-sized trees cut at 18 inches make a strong growth and are susceptible of being properly trained, and that medium-sized trees cut down to 4 or 6 inches in height have made the best showing. This treatment will be found advantageous in getting sweet cherries and pear trees started where the soils are sandy. Trees that were not cut off sustained heavy loss and the surviving ones made but little growth.

Sun scald.—The effect of sun scald, which has caused the loss of a large number of trees throughout the district, can be much reduced by shading the trunk of the tree at the ground with straw or shingles. Wrapping with wood veneer is not advisable, because of the fact that it frequently prevents the proper distribution of branches on the body of the tree and involves more outlay than the use of straw or other inexpensive materials. A sod of rye or small bunches of straw placed on the south side of the trees near the base will practically insure them from being injured by sun scald. Trees in need of water are more susceptible to sun scald than those which have sufficient moisture.

Grapes.—Vinifera, or European, grapes freeze down frequently if not covered during the winter. The best covering material to use is the vineyard soil, which can be plowed or shoveled over the vines after they have been pruned at the beginning of cold weather. Sultanina (*Thompson Seedless*) is the most hardy of the varieties so far grown in the vicinity. The Flame Tokay makes a strong growth and produces an abundance of fruit, which is slow to mature unless the vines are pruned to prevent excessive shading. The Alexandria and Black Hamburg do well.

The American varieties are better adapted to this locality than the Viniferas. They are hardy, withstanding the most severe weather, and yield abundant crops of very sweet fruit. The Worden appears to be hardier than the Concord on sandy soils. These two varieties are preferable on account of their superior market value, but they can be supplemented by the Salem, Niagara, and Moore, all of which do well. The proposed establishment of grape-juice factories at Kennewick, Wash., and other places in the Northwest increases the possibility of greater demand for Concords and Wordens.

Crown-gall is prevalent throughout the district on Vinifera grapes. It has also been noted to some extent on cane fruits, prunes, peaches, and apples. Care should be taken in planting not to use any infected nursery stock. Where this trouble is known to exist it is important to prevent its spread to other orchards and vineyards. Because of the present general infection of Vinifera grapes it seems advisable that their culture should be discouraged.

Cane fruits.—Blackberries, raspberries, dewberries, and gooseberries thrive on the fine soils; and on sandy locations loganberries, Lucretia and Premo dewberries, and Evergreen, Lawton, Mammoth, and Himalaya blackberries grow fairly well. Loganberries require covering during winter to prevent the freezing of the canes.

Strawberries.—Strawberries yield abundantly on silt soils, but as a rule they do not pay on sandy soil unless it has been well fertilized. The Clark is preferable for com-

mercial growing on account of its superior shipping qualities. The Gold Dollar and Magoon are being used to some extent. The Miller and Arizona are good for home use, but are too soft to ship successfully. The hill system of culture is preferable because it facilitates the work of keeping the bed free from weeds and the fruit is larger and more easily gathered.

GARDEN AND TRUCK CROPS.

The work of identifying and testing varieties of garden and truck crops is conducted in cooperation with the Office of Horticultural Investigations of the Bureau of Plant Industry. In this work special emphasis is placed upon the determination of the adaptability of the varieties to local conditions and market requirements. During the three years 1910 to 1912, 67 varieties have been tested. In 1912 there were 37 varieties under test, including those which appeared to be the most promising in previous years and some new varieties. Table IV gives the names of the crops included in these tests, the number of varieties of each on trial in 1912, and the total number of varieties tested to date.

TABLE V.—*Garden and truck crops under test at the Umatilla Experiment Farm.*

Kind of crop.	Number of varieties tested.		Kind of crop.	Number of varieties tested.	
	In 1912.	To date.		In 1912.	To date.
Asparagus	2	2	Peanuts	3	2
Rhubarb	5	5	Beans	.....	4
Watermelons	8	14	Corn	3	8
Cantaloupes	3	4	Potatoes	11	18
Eggplant	2	4			
Peppers	.....	6	Total	37	67

Nineteen varieties of tomatoes have been tried out with a view to producing a variety with pronounced immunity from western tomato blight, for a foundation upon which to carry out selection and breeding experiments. Various methods of culture are also being tried to study their effect upon the growth of this plant.

Asparagus.—Asparagus does well on the project and is growing in popularity as a commercial crop. The plants must not be crowded, and the beds should be covered with manure or straw as a mulch during the winter and to protect the young shoots in the early spring. The Palmetto is the best variety so far tested, because of its extreme hardiness.

Melons.—Watermelons of good quality are being grown, but have not been marketed to advantage, on account of the small quantity produced. There is a demand for this product in carload lots, and as it can be cheaply grown the industry should be more extensively developed. The Kleckley Sweet (*Monte Cristo*) is not the heaviest producer of the 14 varieties tried, but it yields the largest percentage of salable melons.

Cantaloupes do not thrive on sandy raw land, but do well on highly fertilized sand and on silt soils. The Emerald Gem and Rocky Ford varieties are preferable, as determined by observations in the district.

Potatoes.—The production of early potatoes is a promising industry on the project, but it sustained a severe check in 1912, when the crop could not be sold to advantage.

Prices are usually good, however, and the output might well be increased. For early production the Early Ohio and Irish Cobbler are the best varieties so far determined. Sommers' Extra-Early, which had been grown but one season, promises to have superior value.

Eggplant.—Eggplant is a promising crop, as it produces heavy yields of fruit of excellent quality. Since the plants are slow to mature, they need to be started in a hotbed. The New York Improved and Black Beauty varieties are preferable. Markets are not yet established for large quantities of eggplant, but from its increasing popularity there appears to be a good future for it.

Onions.—The moist, subirrigated lands, of which there is a rather large area on the project, are adapted to the production of onions. Early spring seeding is necessary to insure a good stand and to get the crop well grown before warm weather comes on. The Prizetaker yields large crops of medium-sized onions, which are preferred by dealers. The Yellow Globe Danvers is a good variety, but not so productive as the Prizetaker. Onions should be sold in carload lots, so as to diminish the cost of marketing.

SOIL IMPROVEMENT.

The virgin soils on the Umatilla project are very deficient in nitrogen and humus. The mineral plant foods are more abundant. The quantities of nitrogen, potash, phosphoric acid, and lime found in two samples, one of sandy soil and one of silt loam, are stated in Table VI.

TABLE VI.—*Analyses of samples of soil on the Umatilla project.*

Constituent.	Sandy soil.		Silt loam, surface.
	Surface.	Subsoil.	
Nitrogen.....per cent..	0.0203	0.0017	0.03
Acid-soluble potash.....do....	.2680	.3600	.39
Acid-soluble phosphoric acid.....do....	.2400	.2650	.19
Acid-soluble lime.....do....	1.1900	.8600	.33

To determine the quickest and most economical method of increasing the productivity of these soils the following experiments have been in progress since 1910:

Experiment No. 1 consists of five plats, all planted to apple trees. Plat No. 1 has a winter cover crop of vetch and one garden crop (fig. 3) grown on it each year. Plat No. 2 has a winter cover crop of vetch and some leguminous summer crop (fig. 4) grown on it and incorporated in the soil each year. Plat No. 3 has rye grown on it each winter and is given an occasional light application of manure. Plat No. 4 has alfalfa in the spaces and strips of cultivated land along the tree rows. Plat No. 5 has a solid stand of alfalfa among the trees.

Experiment No. 2 consists of three tests, which are designed to show, if possible, whether it is best to start an orchard in the virgin soil with no special fertilizer, to start it in this way and enrich the soil with frequent applications of manure and commercial fertilizers, or to start trees on 2-year-old alfalfa sod. Two and one-quarter acres of land are being used for this experiment and four varieties of peach trees are planted in rows running across the plats.

Experiment No. 3 is designed to determine what changes can be brought about in the soil by the repeated use of barnyard manure and commercial fertilizers. Different crops are grown on the entire area each year. Some of these are leguminous crops,

while others are vegetables of some kind. The fertilizers used are nitrate of soda, potash, phosphoric acid, lime, blood meal, tankage, and stable manure. Chemical tests were made before the fertilizers were applied, to determine the condition of the virgin soil, and will be repeated at intervals of two years to determine the rate and nature of any changes which may occur.

F.G. 3.—View in field used for experiments in soil building. Three crops of winter vetch have been plowed under on this field, and the soil has been markedly improved.

A fourth experiment, which seeks to determine the value of different leguminous plants as cover crops and nitrogen accumulators for the local orchard soils, has been in progress since 1910. This test includes 10 different crops, as follows: Sainfoin, or esparsette (*Onobrychis sativa*), red clover, mammoth red clover, crimson clover, sweet clover, alfalfa, Canada field peas, cowpeas, hairy vetch (*Vicia villosa*), and spring vetch (*V. sativa*). In addition to the work being done with these legumes at the

FIG. 4.—Peanuts and milo, following a winter cover crop of vetch, grown between the rows of young orchard trees.

experiment farm, cooperative experiments with some of the more promising crops are in progress with farmers on the Umatilla and Inland irrigation projects, to determine the value of the crops on the different types of soil.

Some very encouraging results have been derived from these experiments. Hairy vetch sown in August or September makes a

rapid early growth the next spring, and can be turned under about May 1. The succulent green material when incorporated in the soil adds a large amount of fertility and greatly increases the water-holding capacity of the soil. A decided improvement can be seen in land where three crops of vetch have been grown and plowed under. The present high price of seed almost prohibits the use of this crop, but it can be effectively used in orchards by allowing a strip to go to seed between the tree rows each year. Spring vetch winterkills, and can not be used for fall seeding.

Red clover and sweet clover (*Melilotus alba*) are valuable cover crops, but are more difficult to grow than vetch. When they are sown in early spring a fair crop of forage can be turned under the following November, and when planted in August a good crop can be grown to plow in the following May or June.

Alfalfa is not desirable as a crop to grow in orchards, on account of the difficulty of its eradication.

Canada field peas when sown in early spring make a rapid growth, and can be plowed under to advantage about June 1. On account of its rapid growth this is the best spring-planted green-manure crop that has been tried.

It is good practice to sow all available land to clover or vetch early in the fall with a view to plowing under a crop of green manure the following spring. The seeding can be done on land producing garden crops, and in orchards at the time of the last cultivation.

TREES AND SHRUBS.

A test, including 34 varieties of 20 hardy shrubs, is being conducted to determine which shrubs are best suited for use in beautifying home grounds in the locality. Some attention is given to trees for shade and for windbreak purposes, and 39 different kinds of trees are being tested in nursery rows in cooperation with the Forest Service. About one-half of an acre is devoted to this nursery work.

For windbreaks, where space can be given for only one row of trees, the black locust and Carolina poplar are desirable. The trees should be planted from 5 to 7 feet apart. If liberally irrigated they will afford considerable protection in three years. The Lombardy poplar may also be used as a windbreak. It should be planted in double rows, on account of its slender habit of growth. These trees should be placed where the roots will not be disturbed, or suckering will result. European larch, Scotch pine, western yellow pine, and Russian oleaster can be expected to grow if good care is given them. They are ornamental, and also effective as windbreaks. Tamarisk, red cedar, privet, and hardy hydrangeas can be successfully grown for ornamental purposes.

IRRIGATION METHODS.

A few tests of irrigation methods of a simple nature have been conducted. These have consisted principally in determining the effects of using moderate and excessive quantities of irrigation water on young apple trees, comparing the quantity of water required in orchards where alfalfa is grown between the trees with that required where no such crop is grown, and making soil-moisture determinations on a few plats which are cultivated and irrigated in different ways. The moisture determinations are made in cooperation with the Biophysical Laboratory, Bureau of Plant Industry. Some observations have been made of the different irrigation methods practiced by the farmers on the project.

To prevent excessive losses from running water in small ditches and to eliminate the undesirable growth of weeds along the ditch banks, concrete pipe lines have been laid on the experiment farm to carry the water to distributing flumes. Concrete diversion and measuring boxes equipped with specially designed weir gates have been installed to facilitate careful measurement and prompt delivery of water to the respective fields. The initial cost of concrete-lined ditches and concrete pipe lines is from 50 to 100 per cent more than that of wooden flumes, but on account of their greater durability and freedom from leakage they are in the end much more economical.

Irrigation methods best suited to the light sandy and silt loam soils have been receiving special attention. Frequent light applications have been found to be more effective and more economical of water than are less frequent heavy applications. The furrow system of applying water is by far the best adapted to the rough topography and porous soil of the region. Relatively short furrows should be used, as heavy losses result from deep percolation where the water is kept running for a time over porous soil in an attempt to run the water long distances.

FARM BUILDINGS.

During 1912 a machine shed and small workshop building was added to the group of farm buildings erected on the farm. The structure is 16 by 40 feet, which gives sufficient room for the machinery and for a small workshop and seed room. A concrete hotbed, 6 by 18 feet, has been constructed to replace a wooden frame which had fallen to pieces in three years from decay.

EXTENSION WORK.

Some educational work is being done from time to time in the way of conducting pruning demonstrations and by giving lectures on various agricultural topics at public meetings. Frequent trips are made to different farms to inspect the crop and soil conditions with which the farmers are confronted and to assist them in their farm operations.

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